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Climate Change Adaptive Livelihood Diversification Strategies and Food Security of Crop Farming Households in Rural Oyo State, Nigeria

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Abstract
Climate change has reduced farm output, food availability and food security (FS) among crop farming households (CFHHs) in Nigeria. Diversifying livelihood activities to cope with climate change may improve FS, although, literature is limited on the relationship between climate change adaptive livelihoods (CCAL) and food security. Hence, CCAL of crop farming households in rural Oyo state, Nigeria and its effects on their FS were assessed. Primary data was collected through a multi-stage sampling technique, using semi-structured questionnaire, from 260 CFHHs. Descriptive statistics, principal component analysis, Herfindahl–Simpson diversification index, Foster-Greer-Thorbecke FS measure, Tobit and logit regression models were used for data analysis. Results show that most CFHH heads were male (83%) and married (75.4%). Mean age was 58 years, while household size was five members. Majority (57.7%) of CFHH heads had a high perception of climate change, but did not diversify their livelihoods (58.1%), while the mean diversification index was 0.42. Most common CCAL was soil testing (16.5%), followed by agro-marketing (7.7%). Formal education, primary occupation as trading and artisan, and access to credit significantly influenced the extent of CCAL undertaken by the CFHHs. Food security line was ₦1186.153 and 50.4% of the CFHHs were food insecure. Diversifying into CCAL, being a male-headed household, having formal education, being married, trading as a secondary occupation and change-in-income after diversification improved food security. Hence, climate change adaptive livelihoods should be encouraged among crop farming households to improve food security.

Keywords: Food security, Climate change adaptive livelihoods, Livelihood diversification, Rural Oyo state, Crop farming households, Food availability

Introduction

Over two-thirds of the global populace relies on agriculture for their livelihoods either primarily or as a secondary occupation (Goedde *et al*., 2019). In the sub-Saharan African countries, more than three-quarters of the population is dependent on rain-fed agriculture (Bjornlund *et al*., 2020). Given the rising global population, which reached 7.7 billion in 2019 (UN, 2019), an increasing number of people are expected to be engaged in agriculture livelihoods. The global challenge of climate change to agriculture livelihoods arise due to changes in climatic averages with consequent variations in the degree and harshness of extreme weather events (IPCC, 2021) causing yield and crop losses with adverse effects on income and welfare, especially food security. Other negative effects of climate change include; changes in soil moisture, soil quality, crop resilience, timing/length of growing seasons, increase in atmospheric temperatures, weed insurgence, flooding, unprecedented droughts, sea level rises and many more (Akinnagbe *et al*., 2014). Primary economies such as in sub-Saharan Africa, which are natural resource-based, are highly susceptible to climate change effects (Jonathan *et al*., 2017). Climate change thus distresses livelihoods at farmer level and reduces sustainable development at national levels, especially in developing countries, thus; leading to food insecurity (Raj, 2022).

Nigeria is not isolated from the adverse effects of climate change on agriculture livelihoods and economy, especially in the rural areas where agriculture is the mainstay of the populace (World Bank, 2022). The bearing of climate change on the agriculture economy has been significant given the combination of high temperature levels, inadequate coping ability and inept monitoring system in the country (Shuaibu *et al*., 2014). Negative effects of climate change have consequent implications incomes (Haq *et al*., 2021) especially in the rural areas which are already suffering more in terms of

poverty and food insecurity (World Bank, 2022). This increases the threat to livelihoods and survival of the rural farming households. Climate change thus, has required many rural farming households to develop adaptation strategies to manage the growing susceptibilities accompanying climate change in agricultural production (Danso-Abbeam, 2021). This is because rural farmers usually direct efforts at attaining sustainable and safe livelihoods through various adaptation strategies despite their restricted dimensions (Ifeanyi-Obi and Nnadi, 2014). Some climate change adaptation strategies may essentially be unfriendly with consequent negative effects on farmers' livelihoods. For instance, diversifying livelihoods into logging, or use of environmentally-hazardous chemicals to combat new strains of pests and diseases that arise due to changing climate, which aggravate environmental consequences, deteriorate livelihood conditions of the rural populace and further plunge them into food insecurity (Adomako and Ampadu, 2015: Akudugu *et al*., 2012).

Livelihood adaptation strategies have included livelihood diversification, intensification and migration. Off-farm and non-farm activities are now vital to livelihoods of rural households in Nigeria. Rural households in agriculture-based livelihoods are the poorest in Nigeria relative to other occupational groups (World Bank, 2022). Therefore, diversification into several agriculture and non-agriculture activities to generate income have become imperative (Ayana *et al*., 2022), especially in the face of varying climatic environments. Hence, in this study, livelihoods undertaken to adapt to the menace of climate change on crop farming are termed Climate Change Adaptive Livelihoods (CCAL). The CCAL include both agricultural and non-agricultural based livelihoods that are not dependent on crop production; hence, not easily susceptible to the variabilities caused by climate change. The study of Babatunde and Qaim (2010) identified non crop dependent livelihoods to include soil testing, marketing of agricultural products, hunting and fishing.

Rural farming households have however, been identified as having low livelihood diversification potential (Danso-Abbeam, 2021). This has implications for the ability to manage the adversities of climate change and the improvement of food security. Given that livelihoods are critical to households' ability to cope with the changing climatic condition and food security, it is important to investigate the link between livelihoods undertaken to adapt to climate change and food security. Public policy has not considered CCAL as a pathway to food security. Past studies are scanty on the effect of climate change adaptive livelihoods on food security of farming households, thus, unable to provide enough basis for making appropriate policy recommendations (Danso-Abbeam, 2021). The crucial research questions raised in this study are: What climate change adaptive livelihood activities are undertaken by the rural crop farming households in the study area? What factors determine the extent of the CCAL undertaken by the crop farming households? What is the food security status of the crop farming households? What is the influence of CCAL on the food security status of the farming households?

Previous studies on livelihood diversification fixated largely on its level and factors, and the overriding income sources of the livelihood activities (Kassie *et al*., 2017; Martin *et al*., 2016; Alobo, 2015; Rahut *et al*., 2014). The studies found that rural households adopt strategies to cope with shocks because they are already facing the deleterious effects or because they anticipate the shocks in the near or farther future. Further, the studies have also shown that diversification into off-farm livelihood activities actually lessen the negative impact of shocks. Hence, livelihood diversification beyond farm-based enterprises could have positive implications for poverty reduction and food security, although, studies on livelihood diversification into off-farm activities due to climate change effects on crop production are not abundant in the literature. Therefore, the climate change adaptive livelihoods undertaken by crop farming households in rural Oyo state, and the impact the livelihoods on the food security status of the households in the study area was investigated in the study.

Methodology

Study area

The study was carried out in Oyo state, located in the South-West geo-political zone of Nigeria. It lies between latitudes $7^0 1'32.74''$ and $9^0 11'7.81''$ N of the equator, and longitudes $2^0 39'59''$and $4^0 34'14.79''$ E of the meridians. The state covers an area of approximately 28,454km^2 with a total population of 5,580,894 and it is ranked 14th in size out of 36 States by NPC (2006). The climate is equatorial, notable with dry and wet seasons with relatively high humidity. The dry season lasts from November to March while the wet season starts from April and ends in October, Average daily temperature ranges between 25^{o}C (77.0^{o}F) and 35^o C (95.0^{o}F), almost throughout the year. It has a Gross Domestic Product of $29.8 billion and per capita of $2,666 (C-GIDD, 2015). Crop farming are the main occupation in the state and commonly grown crops include maize, yam, cassava, cocoyam, vegetables (such as okra, melon, tomatoes and pepper), plantain, banana, cocoa, oil palm and rubber.

Sampling procedure

The study relied on primary data collected from household heads in rural Oyo State using a semi-structured questionnaire. A five-stage sampling procedure was employed for this study. The first stage involved a random selection of one zone out of the four agro-ecological zones in the State; Ibadan/Ibarapa zone. In the second stage, four Local Government Areas (LGAs) from Ibadan/Ibarapa zone were randomly selected, namely: Akinyele, Egbeda, Ido, and Ibarapa North LGAs. The selection of 12 wards from the LGAs, proportionate to size, constitute the third stage, with four wards selected from Akinyele, three wards each from

Egbeda and Ido, and two wards from Ibarapa North LGAs. Twelve villages were randomly selected from the wards, in the fourth stage, while the random selection of 260 rural crop farming household heads made up the fifth and final stage. Selection of respondents was proportionate to the selected ward. Hence, 87, 65, 65 and 43 household heads were chosen from Akinyele, Egbeda, Ido, and Ibarapa North LGAs respectively.

Analytical Methods

Data was analyzed using Descriptive statistics, Principal Component Analysis (PCA), Herfindahl-Simpson diversification index, Tobit regression model, FGT Food security measure and Logistic regression model. Descriptive statistics was used to profile the socio-economic characteristics of the crop farmers, PCA was employed to describe the farming households' extent of perception of climate change, Herfindahl-Simpson diversification index to analyze the extent of climate change adaptive livelihood diversification, Tobit regression model to examine the determinants of the extent of climate change adaptive livelihoods diversification strategies among the crop farming households (CFHHs), the food security index was used to estimate the food security status of the crop farming households, while the Logit regression model was used to determine the influence of climate change adaptive livelihoods engaged in by the CFHHs on their food security status. Following Ahmed *et al*. (2018) and Djido *et al*. (2018), the Herfindahl–Simpson diversification index was used in preference to other methods since this measure of index enables us to use the degree of diversification as a measure of the size of each livelihood activity in relation to its containing groups. The indices are calculated thus:

$$HH_i = 1 - \sum_{i=1}^{n} S_i^2 \quad \ldots. (1)$$

Where; HH is the extent of livelihood diversification, n is the total number of income sources and S_i^2 is the income proportion from the i-th income sources. It was estimated from the total number of livelihood diversification sources and the proportion of income that comes from each source. The value would vary from 0 to 1. Following the work of Onuka and Olumba (2017), Tobit regression model, which was initially established for censored data, was applied for the analysis. The model is specified as:

$$Yi = \beta Xi, \text{ if } i = \beta Xi + ui > Ti \ldots. (2)$$
$$Yi = \beta 0 + \beta iXi + ui \ldots. (3)$$

Where; ui = normally distributed with zero mean and constant variance *Xi* = vector of explanatory variables, βi = vector of the parameter estimates.

The dependent variable Yi= Index of livelihood diversification strategies engaged by the rural crop farming households in the area; which is number of livelihood diversification strategies employed divided by all the livelihood diversification strategies available in the study area. The explanatory variables used which are expected to influence the choice of livelihood diversification are as follows:

X_1 = Sex (male = 1, female = 0), X_2 = Education (formal = 1, otherwise = 0), X_3= Total income received (₦), X_4= Primary Occupation of trading (Yes = 1, No = 0) , X_5 = Primary Occupation of artisan (Yes = 1, No = 0), X_6 = Primary Occupation in Civil service (Yes = 1, No = 0), X_7 = Access to credit (access credit = 1, otherwise = 0), X_8 = Membership of any association (association member = 1, otherwise = 0), u_i= Error term

The Foster-Greer-Thorbecke food security measure was used to assess the food security status of the CFHH. The basic formula is given as:

$$P = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z-y_i}{z}\right] \blacksquare \ldots. (4)$$

Where; P_i = food insecurity level of the ith household, yi = total household food expenditure of the ith household, q = number of persons with food expenditure below the food security line (z), n = total number of persons, z = food security line, = FGT parameter which takes the values 0, 1 and 2 depending on the degree of food insecurity. The food security line was given by two-thirds of mean per capita household food expenditure (MPCHHFE). Hence, any household with food expenditure equal to or above the food security line was categorized as food secure, while household with food expenditure below the food security line were categorized as food insecure.

The logit model was used to explain the relationship between food security status variable *Si* and the independent variables *Ri* and given thus;

$$S_i = \alpha Ri + \mu i \ldots. (5)$$

Where; S_i = 1 for Ri >0 otherwise and i= 1, 2, 3…n, S_i = food security status of the rural crop farming households' in the study area, Ri is a vector of explanatory variables and α is the vector of parameters. The Logit model computes a maximum likelihood estimator of α given the non-linear variable, which is one when the household is food secure and zero if otherwise. The explanatory variables (Ri) used are: R_1 = Diversification into CCAL index, R_2 = Age of household head (years), R_3 = Sex of household head (male = 1, female = 0), R_4= Education (formal = 1, otherwise = 0), R_5 = Marital status (married = 1, otherwise = 0), R_6 = Trading as secondary occupation (Yes = 1, No = 0), R_7= Artisan as secondary occupation (Yes = 1, No = 0), R_8= Civil service as secondary occupation (Yes = 1, No = 0), R_9 = Member of an association (member = 1, otherwise = 0), R_{10}= Change in income after diversification (₦), μ_i= error term.

Results and discussion

The socioeconomic characteristics of rural crop farming household heads is shown on Table 1. The result reveals that, more than half the farmers (56.5%) are below 60 years of age, while the mean age is 57.6±12.7 years. This shows that majority of the farmers are still within their

active age to carry out agricultural activities. This result agrees with the findings of Adepoju and Olawuyi (2013) that over 50% of the farmers are below 60 years of age. Most rural crop farmers are male (83.1%) and married (75.4%) with household size of about five persons. Similarly, most of the farmers do not belong to any association (53.1%), although; they mostly have formal education (83.8%) and are primarily engaged in farming as their main occupation (59.6%). This suggests that the farmers may be aware of climate change and have knowledge of appropriate climate change adaptive livelihoods to diversify into. Table 2 shows the level of perception about climate change among the CFHH heads. The results indicates that more than half (57.7%) of the respondents had a high level of perception with index between 0.3001-1.000, while 25.4% and 16.9% had low and moderate level about climate change, respectively. The mean perception index among the CFHH heads was 0.46, indicating high level of climate change. This might suggest that majority of the rural farming households were familiar with the environmental issue of climate change and had experienced its effects including: increased temperature, changes in rainfall patterns, droughts, increasing frequency of natural disasters, in the past.

The distribution of the climate change adaptive livelihood (CCAL) activities engaged in by the rural crop farming households in the study area is shown on Table 3. Majority (58.1%) of the CFHH heads did not engage in any climate change adaptive livelihood activity, while 16.9% diversified into soil testing, which was the most common CCAL diversified into by the respondents. The second most common activity diversified into by the CFHH heads was agro-marketing by 7.7%, and third was fishing (6.2%). This result is in line with the findings of Alawode *et al.* (2017) who also found that rural households mostly diversified into livelihood activities other than crop farming. The distribution of livelihood diversification index, which shows the extent of diversification among crop farming households, is presented on Table 4**.** The mean livelihood diversification was 0.42, hence, majority (58.1%) of the faming households were not diversified. This indicates that most CFHH had only a source of income and might be food insecure. This result contradicts the findings of Mailumo *et al.* (2016) that found that majority of farming households in their study area were highly diversified.

The determinants of the extent of climate change adaptive livelihoods activities engaged in by the crop farming households in rural Oyo State are shown in Table 5. The results show that sigma was 0.1586 and statistically significant at 1%; indicating that the model is good. The Tobit regression estimates revealed that education was negative and significant at 1% level, indicating that having formal education reduces the probability and intensity of household's diversification into the climate change adaptive livelihoods. This is plausible that education makes an individual to have knowledge of a variety of activities other than crop production which may not be easily affected by climate change. Education also helps farmers to adopt technologies such as improved varieties that could mitigate the climate change effects on crop production; hence, they may have less need to diversify into climate change adaptive livelihoods. This is in line with the works of Ahmed *et al.* (2018) that found out that education had a negative and significant effect on livelihood diversification. On the other hand, engaging in trading and artisan crafts as primary occupation was positive and significant at 10% and 5% levels, respectively in influencing the probability and intensity of CCAL diversification. Hence, being primarily a trader or artisan increases the probability of diversification into climate change adaptive livelihoods. This is in line with the works of Fosu-Mensah *et al.* (2012). Access to credit was also positive and significant at 10% level. This is expected as credit increases the funds available to diversify into climate change adaptive livelihoods thus, increasing the extent of climate change adaptive livelihoods engaged in by the crop farming households in the study area. This contradicts the findings of Dinku (2018) who found that not having access to credit increases the extent of livelihood diversification among pastoral communities in Ethiopia.

The food expenditure of the crop farming households' is shown in Table 6. The total per capita household food expenditure of all the CFHH was ₦462, 599.24, while the mean per capita household food expenditure was ₦1,779.23. The food security line was two-third of the mean per capita food expenditure of all households and estimated as ₦1,186.15. This result is in line with the findings of Onunka and Olumba (2017) who obtained a similar food security line for farming households. The distribution of the crop farming households by their food security status is shown in Table 7. More than half of the households were below the food security line and thus, food insecure, as indicated by the food insecurity incidence of 50.4%. The food insecurity depth was 13.7%, indicating that the food insecure households, on the average, need 13.7% increase in food income to attain food security. The severity of food insecurity among the respondents was 5.4%. which infers that the most food insecure households require 5.4% more food income than the average food insecure household. This result agrees with the findings of Omotesho *et al.* (2006), who found a high prevalence of food insecurity among households in rural Nigeria whereas, it contradicts the findings of Mailumo *et al.* (2016) that majority of farming households in Nigeria are food secure.

The logit estimates for the effect of climate change adaptive livelihoods on food security are shown in Table 8. The likelihood-ratio test of the hypothesis which tests that the coefficients of all the explanatory variables are zero has a Chi-square value of 47.42, which suggests that the estimated model is highly significant. The Pseudo R^2 (0.3) also gives a satisfactory fit. The results reveal that diversifying into climate change adaptive livelihoods was significant at 10% level and positively

related to probability of being food secure among the CFHH. Thus, increased diversification into climate change adaptive livelihoods increased the likelihood of being food secure by 40%. It is expected that the enhanced income from the CCAL will improve the households' expenditure on food and consequently, their food security. This result is in line with the work of Agboola (2004) and Echebiri, *et al.* (2017) who found that a higher level of diversification in non- farming activities will lead to a higher food security level among rural crop farming households. Moreover, being a male household head, having formal education, being married, engaged in the secondary occupation of trading and the change in income after diversification were found to positively influence food security at various levels of significance. Hence, being a male household head increased the likelihood of food security for the rural CFHH by 26%. This may be because males are freer to engage in more livelihood activities and generate more income, which impacts positively on their food security status, whereas, women are more restricted by house chores and child care. This result disagrees with Aboaba *et al*. (2020) who found that being a female improves food security status. Similarly, having formal education increased the likelihood of food security for the rural CFHH by 3.3%. Formal education increases the chances of higher incomes and helps the farmers to gain knowledge on food and nutrition; hence, they are able to improve their diets and, food security. Similarly, being married increased the likelihood of being food secure for the rural CFHH by 57%. Marriage puts a sense of responsibility on person to cater for the family, including provision of adequate foods, which may invariably serve to improve the food security status. This result agrees with Aboaba *et al*. (2020) who found that being married improves food security status of rural households. Additionally, secondary occupation of trading increased the likelihood of being food secure for the rural CFHH by 23.4%. The income earned from trading is likely to have a positive effect on food expenditure and invariably, on food security. This result agrees with Fosu-Mensah *et al*. (2012) who found that off-farm income improves food security. Furthermore, the change in income after diversifying into CCAL increased the likelihood of food security for the rural CFHH by 27.8%. Diversifying into CCAL is expected to increase household income with consequent increase in food expenditure and improvement in household food security. This result is also in line with Fosu-Mensah *et al*. (2012).

Conclusion

The study established that rural crop farming households have a high perception to climate change although diversification into climate change adaptive livelihoods among farming household was low. Moreover, access to credit and secondary occupation influenced the extent of climate change adaptive livelihoods engaged by the rural crop farmers. The study further established that most of the rural crops farming households are food insecure. Food security status of rural crop farming households is improved by the extent of diversification into climate change adaptive livelihoods, being a male household head, having formal education, being married, having a secondary occupation of trading and the change in income after diversification. The study concludes that the extent of diversification into climate change adaptive livelihoods has positive effects on the food security. Hence, policy options on food security of rural crop farming households should encourage their diversifying into climate change adaptive livelihoods in order to improve their food security. The farmers should be encouraged to take up secondary occupation of trading as it improves food security status.

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Table 1: Socioeconomic characteristics of rural crop farming household heads

Variables	Frequencies	Percentages	Mean	Std.Dev.
Age			57.6	12.7
20-29	6	2.3		
30-39	13	5		
40-49	65	25.0		
50-59	63	24.2		
60-69	68	26.2		
70-79	45	17.3		
Sex				
Male	216	83.1		
Female	44	16.9		
Marital status				
Single	6	2.3		
Married	196	75.4		
Widow	35	13.5		
Divorced	23	8.9		
Household size			4.7	1.5
1-4	130	50		
5-8	128	49.2		
9-12	2	0.8		
Membership of association				
Membership	122	46.9		
No membership	138	53.1		
Level of formal education				
No formal education	42	16.2		
Primary	86	33.1		
Secondary	68	26.2		
Tertiary	64	24.7		
Primary Occupation				
Farming	155	59.6		
Trading	38	14.6		
Artisan	29	11.2		
Civil servant	23	8.8		
Others	15	5.8		

Source: Field survey, (2019)

Table 2: Level of perception about climate change among farming households

Level of perception	Frequencies	Percentages	Mean	SD
Low (0- <0.15)	66	25.4		
Moderate (0.15001-0.30)	44	16.9		
High (0.3001-1.0)	150	57.7		
Total	260	100.0	0.46	0.34

Source: Field Survey, 2019

Table 3: Distribution of climate change adaptive livelihood activities engaged by the rural crop farming households

Climate change adaptive livelihood activities	Frequencies	Percentages
None	151	58.1
Soil testing	43	16.5
Agro-marketing	20	7.7
Fishing	16	6.2
Off season cropping	11	4.2
Hunting	7	2.7
Basket weaving	3	1.2
Drip irrigation	3	1.2
Palm wine tapping	3	1.2
Livestock	3	1.2
Total	260	100

Source: Field survey, 2019

Table 4: Distribution of livelihood diversification index of the rural farming households

Livelihood diversification index	Frequencies	Percentages
Not Diversified	151	58.1
Diversified	109	41.9
Total	260	100
Mean	0.42	
Standard deviation	0.49	

Source: Field survey, 2019

Table 5: Determinants of extent of climate change adaptive livelihoods engaged by rural crop farming households

Variable	Coefficient	Standard Error	t- value	P>t
Sex	0.0402945	0.0332425	1.21	0.227
Education	-0.1018143***	0.038521	-2.64	0.009
Total Income	0.0277999	0.0309913	0.9	0.371
Trading	0.0633611*	0.0381155	1.66	0.098
Artisan	0.077478**	0.0351497	-2.2	0.028
Civil servant	0.0250354	0.050947	0.49	0.624
Access to credit	0.0518129*	0.031441	-1.65	0.101
Member of association	0.0439781	0.031036	1.42	0.158
Constant	0.5456932	0.3285784	1.66	0.098
/sigma	0.1586102	0.0069824		

Source: Field survey, (2019). ***Significant at 1%, **significant at 5%, *significant at 10%. Log likelihood = 108.9708, LR Chi^2(11) = 19.79, Prob > Chi^2 = 0.0482

Table 6: Food security line of rural farming households

Food expenditure measures	Values
Total per capita household food expenditure	₦462599.24
Mean per capita household food expenditure	₦1779.23
Standard deviation of the mean per capita household food expenditure	₦1788.98
Two-thirds of mean per capita household food expenditure	₦1186.15

Source: Field survey, 2019

Table 7: Distribution of crop farming households' food security index

Food security status	Frequencies	Percentages
Food insecure	131	50.4
Food secure	129	49.6
Total	260	100
Food insecurity incidence	0.504	
Food insecurity depth	0.137	
Food insecurity severity	0.054	

Source: Field survey, 2019

Table 8: Effect of climate change adaptive livelihoods on the food security status

Variable	Coefficient	Standard Error	P>z	dy/dx
Diversification index	2.791885*	1.708674	0.102	0.4013347
Age	0.0195873	0.271044	0.942	0.0028157
Sex	1.840366**	0.9188233	0.045	0.2645534
Education	0.2296654***	0.0719051	0.001	0.0330145
Marital status	3.963245**	1.660747	0.017	0.5697181
Trading	1.62727**	0.7319907	0.026	0.2339207
Artisan	-0.1883864	0.9377841	0.841	-0.0270806
Civil servant	-2.075201	1.678082	0.216	-0.2983111
Member of association	1.038652	1.013609	0.306	0.1493067
Change in income after diversification	1.934264***	0.7366618	0.009	-0.2780512
1.acced	0.4563287	0.8749074	0.602	0.0655974
1.rem	-0.5948667	0.6609809	0.368	-0.0855123
cons	9.411894	10.42799	0.367	

Source: Field survey, (2019). ***Significant at 1%, **significa nt at 50%, *significant at 10%. Number of observations = 116. LR Chi^2 (15) = 47.42. Prob> Chi^2 = 0.0000. Log likelihood = -51.016901. Pseudo R^2 = 0.3173